

40. The method of claim 16, wherein the depositing and the annealing are carried out in one chamber.

41. The crystallizing apparatus according to claim 22, wherein the heat supplied by the heater is in a range from 300 °C to 1000 °C. --

REMARKS

The Applicants have: amended claims 1-2, 11-12, 16, and 22; canceled claims 20, 21 and 23; and added new claims 26-41. Accordingly, claims 1-19, 22 and 24-41 remain pending in the application.

35 U.S.C. § 102 and 103

The Examiner has rejected claims 1-5, 10-13, and 16-19 under 35 U.S.C. § 102 as being anticipated by Makita et al., and claims 7-9, 14-15 and 22 and 24-25 under 35 U.S.C. § 103(a) as being unpatentable over Makita.

In the method of the amended claim 1, an inducing substance is deposited directly on an exposed surface of an amorphous silicon layer. Support for this feature may be found in the specification at page 8, lines 6-7, 9-10, 14-15 and 25-36.

In contrast, in Makita, the surface of the amorphous silicon layer is not exposed during

the process of depositing a catalyst element, because the catalyst element penetrates into an insulating film which has already been formed on the amorphous silicon layer. Indeed, Makita teaches that an amorphous silicon film and an insulating film should be continuously formed without exposing the amorphous silicon film to the atmosphere (see, e.g., col. 10, lines 6-11; col. 11, lines 48-52; col. 12, lines 23-29 and 52-60; col. 13, lines 45-62; col. 15, lines 49-52; col. 17, lines 1-8; col. 18, lines 48-51; col. 18, line 60 - col. 19, line 5). Then, the catalyst element (e.g., Ni) for promoting crystallization of the amorphous silicon film is implanted through the insulating thin-film into the amorphous silicon film by an ion implantation method or plasma CVD processing (see col. 15, lines 53-56). The amorphous silicon film into which the catalyst element is implanted is then crystallized by heat treatment. Unfortunately, the insulating element can deteriorate because of the catalyst element included therein (see col. 21, lines 66-67). To solve the problem, there should be another process such as partially etching away the insulating film (col. 22, lines 1-13) or forming a diffusion barrier film on the insulating film (col. 22, lines 42-62).

The method of the present claimed invention wherein an inducing substance is deposited directly on an exposed surface of an amorphous silicon layer does not suffer these drawbacks. Accordingly, Applicants respectfully submit that claim 1 is not anticipated by Makita and is patentable thereover.

Claims 2-5, 7-9, 10-13, and 14-15, dependent from claim 1, are similarly deemed allowable.

Claim 16 has been amended for clarification and recites that the steps of depositing an inducing substance for silicon crystallization on the amorphous silicon layer by plasma exposure is performed while annealing the amorphous silicon layer. Support for this feature may be found in the specification, for example, at page 7, lines 18-19, 21-22.

In contrast, the Makita teaches that the deposition of the inducing substance (e.g., Ni) precedes the annealing or crystallization step. See Makita at col. 23, lines 30-32; col. 26, lines 2-8. Makita does not teach or suggest that these steps can be carried out simultaneously.

For at least this reason, Applicants respectfully submit that claim 16 is patentable over Makita. Claims 17-19, dependent from claim 16, are similarly deemed allowable.

As amended, claim 22 is drawn to a crystallizing apparatus which generates a plasma for depositing a crystallization catalyst while at the same time providing heat for performing the crystallization. Applicant respectfully submits that no such apparatus is taught or suggested by Makita nor would the production of such an apparatus have been obvious to one skilled in the art at the time of Applicants' invention.

For at least this reason, Applicants respectfully submit that claim 22 is patentable over Makita. Claims 24-25, dependent from claim 22, are similarly deemed allowable.

New Claims 26-41

By this amendment, Applicants have added new claims 26-41, each dependent from claims 1, 2, 16 or 22.

Applicants respectfully submit that claims 26-41 are all allowable for at least the reasons set for the above with respect to claims 1, 2, 16 or 22 from which claims 26-41 depend.

Further, claims 26-28, 31-33 and 26-28 each recite that annealing is carried out to crystallize substantially an entire amorphous silicon layer in various claimed time periods, all of which are less than four hours. Support for this feature may be found in the specification, for example, at page 10, lines 19-26. The specification teaches that it is one object of the present invention to accelerate the crystallization of amorphous silicon. Page 3, lines 27-29.

In contrast, the methods taught by Makita all require an annealing time of at least about four hours. Makita at col. 9, lines 10-12. Indeed, Makita discloses the crystallization times for its six examples range from several hours to several tens of hours. Makita at col. 14, lines 15-19 (Example 1); col. 17, lines 14-16 (Example 2); col. 19, lines 33-37 (Example 3); col. 26, lines 2-8 (Example 4); col. 29, lines 30-33 (Example 5); and col. 32, lines 19-22 (Example 6). Accordingly, Makita cannot obtain the objectives and advantages of the present claimed invention.

For at least this additional reason, Applicants respectfully submit that claims 26-28, 31-33

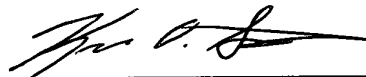
and 36-38 are patentable over Makita.

In view of the foregoing, Applicants respectfully request that the application be reconsidered, that claims 1-19, 22 and 24-41 be allowed, and the application pass to issue. Please charge any insufficiency or credit any overpayment to Deposit Account No. 50-0911.

Respectfully submitted,

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Version With Markings to Show Changes

1. (Amended) A method of crystallizing amorphous silicon, comprising [the steps of]:
depositing an inducing substance for silicon crystallization on an exposed surface of an
amorphous silicon layer by plasma exposure; and
annealing the amorphous silicon layer.
2. (Amended) A method of crystallizing amorphous silicon, comprising [the steps of]:
providing a substrate on which an amorphous silicon layer is formed;
depositing an inducing substance for silicon crystallization on an exposed surface of an
amorphous silicon layer by plasma exposure; and
annealing the amorphous silicon layer.
11. (Amended) The method of claim 1, wherein the inducing substance for silicon
crystallization is a transition metal.
12. (Amended) The method of claim 1, wherein the inducing substance for silicon
crystallization is a noble metal.
16. (Amended) A method of crystallizing amorphous silicon, comprising [the steps of]:
depositing an inducing substance for silicon crystallization on an amorphous silicon layer
by plasma exposure [as soon as] while annealing is carried out on the amorphous silicon layer.

22. (Amended) A crystallizing apparatus, comprising:

a chamber having inner space;

a substrate support arranged in the chamber, the substrate support being used for supporting a substrate having an amorphous silicon layer formed thereon;

a plasma generating device having a metal source connected to [the chamber] a power supply, the plasma generating device producing plasma inside the chamber by supplying the metal bar with RF or DC power from the power supply to deposit a crystallization catalyst on the substrate;

a heater arranged at the substrate support, the heater supplying the substrate with heat for performing crystallization while the plasma generating device produces plasma inside the chamber.

Claims 20, 21 and 23 have been canceled.

Claims 26-41 have been added.